Application Note: AN30062_E

EX03 Ion Cleaning Gun

Key Words
- Surface Analysis
- Sample Cleaning

Introduction

Thermo Electron offers two ion guns, the EX03 and the EX05. The EX03, Figure 1, is intended mainly for sample cleaning prior to surface analysis while the EX05 is designed for high-resolution depth profiles in both XPS and Auger. This document describes the EX03 ion gun.

Figure 1: EX03 Ion Gun.

Construction

The EX03 ion gun is mounted on a 70 mm outside diameter flange with a 34 mm outside diameter flange for the gas input. The gun consists of two main parts, the gas line cover, and the lens column. Separating the two parts gives access to the twin filament assembly.

Figure 2 is a schematic diagram, showing the important components of the EX03.

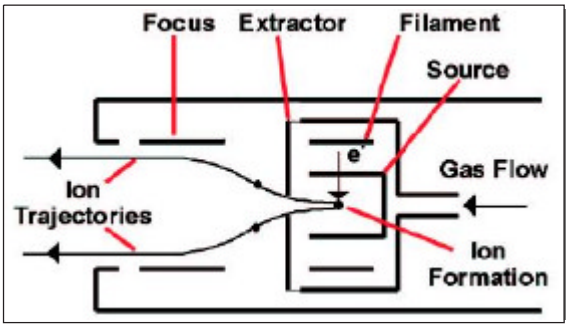

Figure 2: Schematic diagram of the EX03 ion gun.

The general function of the EX03 is to ionise gas atoms in the source region of the ion gun, accelerate them and transfer these ions to the sample via the lens column. Ions are produced at a high positive potential and are accelerated through the gun to produce a beam of ions whose energy is between 500 eV and 3 keV.

Gas is fed directly into the source region. One of the two filaments within the source region is heated to emit electrons. The electrons are accelerated to the source cage. The electrons traverse the source cage and collide with gas atoms, removing electrons and forming positive ions.

Ions produced in the source region are accelerated through an aperture in the extractor lens element by the positive potential. The beam is then shaped and focused onto the sample using an electrostatic lens to control the diameter of the ion beam.

The beam current (flux of positive ions) is dependent on the several factors, but essentially can be controlled by the gas pressure and emission current. The emission current is the electron current flowing from the filament to the source cage and gives an indication of the number of electrons flowing through the ionisation region. The pressure determines the number of atoms within the ionisation region.

The gas is fed directly into the ion gun, allowing systems to operate at a better vacuum compared with guns that require the chamber to be back filled. Typically 3×10^{-6} mbar in the vacuum chamber will achieve target currents >20 µA with no differential pumping.

Beam Profile

When cleaning samples, it is essential to have uniform etching across the whole analysis region. The EX03 ion gun achieves this by producing a flat beam profile over a large area. This provides a low cost alternative for uniform sample etching without scanning. The optical design and focusing allow uniform etch profiles at a range of long working distances.

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A typical beam profile from the EX03 is shown in Figure 3, note the flatness of the profile over a range of more than 10 mm.

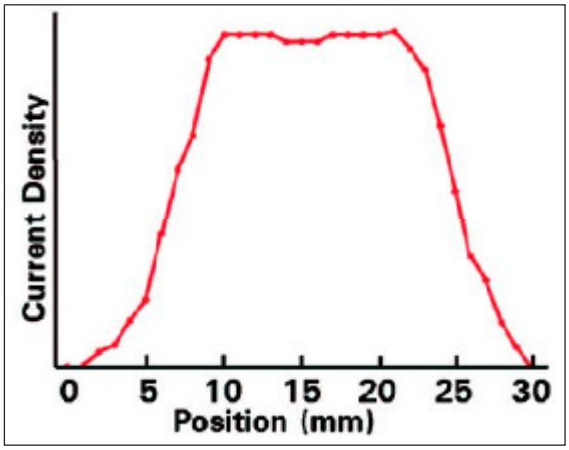

Figure 3: The beam profile from the EX03.

Spot Size

The range of spot sizes available depends upon the ion energy, as illustrated in Figure 4.

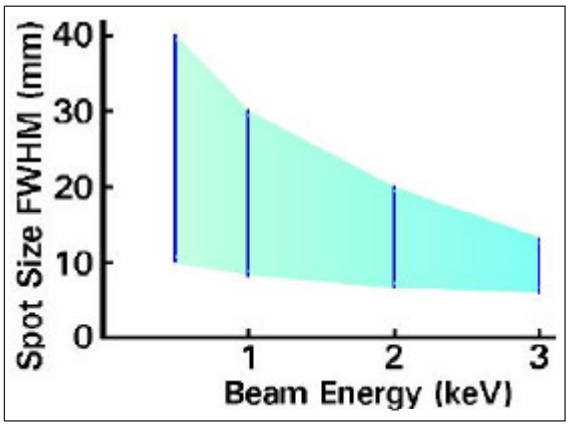

Figure 4: The spot sizes available from the EX03.

EX03 Specifications

Energy range:	0.3 to 3 keV
Target current:	>20 µA (at 3 keV)
	>10 µA (at 500 eV)
Working distance:	50 to 200 mm
Gas species:	Inert gases
Mounting flange:	70 mm UHV

Dimensions

The dimensional information is shown in Figure 5.

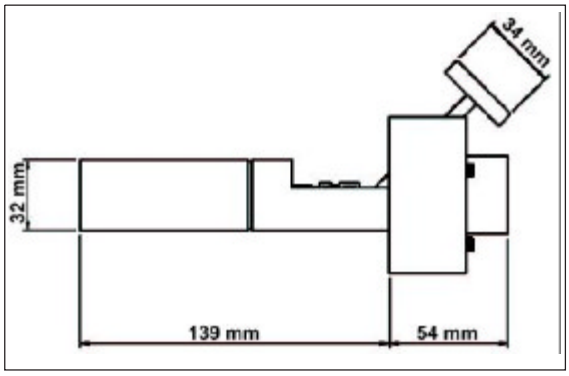

Figure 5 EX03 dimensions.

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